

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claim 1. (Currently Amended) A method of polymerizing poly(cyclic)olefin monomers comprising:

(a) combining a monomer composition comprising one or more poly(cyclic)olefin monomers, a non-olefinic chain transfer agent and an ~~optional~~ activator compound in a reaction vessel to form a mixture; and

(b) adding a polymerization catalyst containing Ni and/or Pd ligated only by a monodentate ligand, the catalyst causing the mixture to polymerize;

wherein the non-olefinic chain transfer agent includes one or more compounds selected from the group consisting of H₂, alkylsilanes, alkylalkoxysilanes, alkylgermanes, alkylalkoxygermanes, alkylstannanes, and alkylalkoxystannanes,

further wherein said activator has a functional group containing an active hydrogen with a pKa of at least about 5.

Claim 2. (Cancelled)

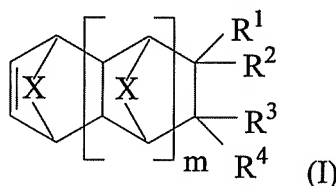
Claim 3. (Currently Amended) The method of claim 1, ~~wherein the non-olefinic chain transfer agent comprises H₂, and~~ wherein said polymerization catalyst contains Ni, and at least one of said monodentate ligands is selected from the group consisting of toluene, benzene, mesitylene, tetrahydrofuran, dioxane, diethylether, ethylacetate, methylacetate, and propylacetate.

Claims 4-5. (Cancelled)

Claim 6. (Currently Amended) The method of claim [4] 1, wherein the ~~functional group~~ active hydrogen of said activator is -OH an alcoholic hydrogen.

Claim 7. (Currently Amended) The method of claim [4] 6, wherein the activator is ~~a compound containing an OH functional group~~ selected from water and C₁-C₂₄ linear, branched, and cyclic alkyl, aryl, and alkaryl moieties, in each case containing at least one hydroxyl group alcoholic hydrogen as said active hydrogen.

Claim 8. (Currently Amended) The method of claim 1, wherein the poly(cyclic)olefin monomers comprise a first monomer according to Formula (I):

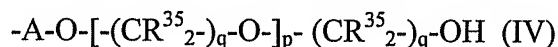


wherein X is selected from -CH₂-, -CH₂-CH₂-, O, S, and -NH-; m is an integer from 0 to 5; and each occurrence of R¹, R², R³ and R⁴ is independently selected from one of the following groups:

- a) H, halogen, linear, branched or cyclic C₁ to C₃₀ alkyl, aryl, aralkyl, alkaryl, alkenyl or alkynyl;
- b) linear or branched C₁ to C₂₄ halohydrocarbyls, -(CH₂)_nC(O)OR*, -(CH₂)_nC(O)OR', -(CH₂)_nOR, -(CH₂)_nOC(O)R, -(CH₂)_nC(O)R, -(CH₂)_n-OC(O)OR', -(CH₂)_nC(R)₂CH(R)(C(O)OR**), -(CH₂)_n(CR₂)_nCH(R)(C(O)OR**), -(CH₂)_nC(OR***)(CF₃)₂, -(CR''₂)_nOR, -CH₂-[O(CH₂)_n]_{m*}-C(OR***)(CF₃)₂, -(CH₂)_nC(R)₂CH(C(O)OR**), -(CH₂)_nC(O)OH, (CH₂)_nC(R*)₂CH(R*)(C(O)OH), -(CH₂)_n-C(O)-O-R¹⁸, -(CH₂)_n-C(CY₃)₂-OH, and -(CH₂)_nC(R*)₂CH(C(O)OH)₂; where each occurrence of R is independently selected from H and linear or branched C₁ to C₁₀ alkyl; R' is a linear or branched C₁ to C₁₀ alkyl or alkylol; R'' is selected from H and halogen; n and m* are each an integer from 0 to 10; R* represents an acid labile group cleavable by a photoacid generator; R** is selected from R' and R* as defined above and tertiary C₄ to C₂₀ alkyl and cycloalkyl, C₁ to C₆ trialkylsilyl groups, and C₄ to C₂₀ oxoalkyl; R*** is selected from H, -CH₂OR''', -C(O)OR''' and -C(O)R''', where R''' is selected from methyl, ethyl, t-butyl, and C₁ to C₂₀ linear or branched cycloaliphatic, R¹⁸ is selected from H, and linear, branched or cyclic C₁-C₂₄ alkyl, aryl, aralkyl, and alkaryl, Y is selected from F and Cl and at least one occurrence of Y is F;

e) C₁ to C₃₀ linear, branched, or cyclic alkyl, aryl, aralkyl, alkaryl, alkenyl or alkynyl containing one or more hetero atoms selected from O, N, and Si;

d) a hydroxy alkyl ether according to Formula (IV):



wherein A is a linking group selected from C₁ to C₆ linear, branched, or cyclic alkylene, each occurrence of R³⁵ is independently selected from H, methyl, ethyl and a halide, q is from 1 to 5, and p is from 0 to 3;

e) a group according to Formula (V):



where R³⁶ is a linear, branched or cyclic C₁ to C₃₀, optionally partially or completely halogenated, alkylene, arylene, aralkylene, alkarylene, alkenylene or alkynylene linking group and Z is a functional group selected from hydroxyl, carboxylic acid, amine, thiol, isocyanate and epoxy; and

f) C_rXⁿ_{2r+1}, wherein Xⁿ is independently a halogen selected from fluorine, chlorine, bromine or iodine and r is an integer from 1 to 20.

Claim 9. (Original) The method of claim 8, wherein m=0.

Claim 10. (Currently Amended) The method of claim 8, wherein m=0, at least one of R¹-R⁴ is the hydroxy alkyl ether according to Formula (IV), and the remaining R², R³, and R¹-R⁴ are each H in the poly(cyclic)olefin monomer.

Claim 11. (Original) The method of claim 8, wherein A is methylene or ethylene, each occurrence of R³⁵ is H, q is from 2 to 5, and p is 0 in the poly(cyclic)olefin monomer.

Claim 12. (Currently Amended) The method of claim 8, wherein m=0, X is ~~-CH₂-, R¹-, R²- and R³-are hydrogen,~~ and at least one of R¹-R⁴ is

$-(CH_2)_n-C(OR^{***})-(CF_3)_2$ where n and R^{***} is are each as defined above, and the remaining R¹-R⁴ are each H.

Claim 13. (Cancelled)

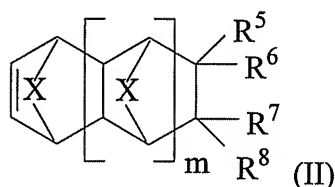
Claim 14. (Previously Presented) The method of claim 1, wherein the poly(cyclic)olefin monomer is selected from the group consisting of α,α -bis(trifluoromethyl)bicyclo[2.2.1]hept-5-ene-2-ethanol, 5-norbornene-2-methanol hydroxyethylether, t-butylester of norbornene 5-carboxylic acid, hydroxyethylester of 5-norbornene carboxylic acid, trimethylsilane ester of 5-norbornene carboxylic acid, 5-norbornene-2-methanol acetate, 5-norbornene-2-methanol, 5-norbornene-2-ethanol, 5-triethoxysilylnorbornene, 1-methylcyclopentyl ester of 5-norbornene carboxylic acid, tetrahydro-2-oxo-3-furanyl ester of 5-norbornene carboxylic acid, and mixtures thereof.

Claim 15. (Original) The method of claim 8, wherein the acid labile groups, denoted R*, in the poly(cyclic)olefin monomer are selected from the group consisting of $-C(CH_3)_3$, $-Si(CH_3)_3$, isobornyl, 2-methyl-2-adamantyl, tetrahydrofuranyl, tetrahydropyranoyl, 3-oxocyclohexanonyl, mevalonic lactonyl, dicyclopropylmethyl, dimethylcyclopropylmethyl and mixtures thereof.

Claim 16. (Original) The method of claim 8, wherein R** in the poly(cyclic)olefin monomer is selected from the group consisting of tert-butyl, tert-amyl, 1,1-diethylpropyl, 1-methylcyclopentyl, 1-ethylcyclopentyl, 1-butylcyclopentyl, 1-methylcyclohexyl, 1-ethylcyclohexyl, 1-butylcyclohexyl, 1-ethyl-2-cyclopentenyl, 1-ethyl-2-cyclohexenyl, 2-ethyl-2-adamantyl, trimethylsilyl, triethylsilyl and dimethyl-tert-butylysilyl, 3-oxocyclohexyl, 4-methyl-2-oxooxan-4-yl, and 5-methyl-2-oxooxolan-5-yl.

Claim 17. (Previously Presented) The method of claim 8, wherein the

poly(cyclic)olefin monomers further comprise a second monomer according to Formula (II):



wherein m is an integer from 0 to 5; X is selected from $-\text{CH}_2-$, $-\text{CH}_2\text{CH}_2-$, O , S , and $-\text{NH}-$; R^5 to R^8 are independently selected from H , $-(\text{CH}_2)_n\text{C}(\text{O})\text{OR}''$, $-(\text{CH}_2)_n\text{OR}'$, $\text{Si}(\text{OR}')_3$, $-(\text{CB}_2)_n\text{OC}(\text{O})\text{R}''$, $-(\text{CH}_2)_n\text{OC}(\text{O})\text{OR}''$, $-(\text{CH}_2)_n\text{C}(\text{O})\text{R}'$, $-(\text{CH}_2)_n\text{C}(\text{R}^*)_2\text{CH}(\text{R}^*)(\text{C}(\text{O})\text{OR}^{**})$, $-(\text{CH}_2)_n\text{C}(\text{R}^*)_2\text{CH}(\text{C}(\text{O})\text{OR}^{**})_2$, $-\text{C}(\text{O})\text{O}-(\text{CH}_2)_n\text{OR}'$ and $-(\text{CH}_2)_n\text{O}-(\text{CH}_2)_n\text{OR}'$, wherein n is independently an integer from 0 to 10; B is hydrogen or a halogen; R^* is independently hydrogen, a halogen, C_1 to C_{10} linear or branched alkyl or cycloalkyl, or C_1 to C_{10} linear or branched halogenated alkyl or cycloalkyl; R^{**} is independently C_1 to C_{10} linear or branched alkyl or cycloalkyl or C_1 to C_{10} linear or branched halogenated alkyl cycloalkyl; R' is independently hydrogen, a linear or branched (C_1 to C_{10}) alkyl group or cycloalkyl group or a linear or branched (C_1 to C_{10}) halogenated alkyl group or halogenated cycloalkyl group; and R'' is independently C_1 to C_{10} linear or branched alkyl or halogenated alkyl, C_4 to C_{20} monocyclic or polycyclic cycloaliphatic or halogenated cycloalkyl moiety, a cyclic ether, a cyclic ketone or a cyclic ester (lactone), wherein each of the cyclic ether, ketone and ester can be halogenated or not.

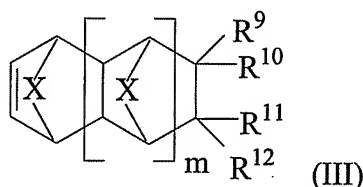
Claim 18. (Original) The method of claim 17, wherein $m=0$ in the second monomer.

Claim 19. (Previously Presented) The method of claim 17, wherein the cycloaliphatic groups of R^* are selected from the group consisting of cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, 1-adamantyl, and 1-norbornene.

Claim 20. (Original) The method of claim 17, wherein the groups R^1 to R^4 and R^5 to R^8 in the poly(cyclic)olefin monomers of Formula (I) and Formula (II) are independently selected such that three or more poly(cyclic)olefin monomers are included in the monomer

composition.

Claim 21. (Original) The method of claim 8, wherein the poly(cyclic)olefin monomers further comprise a third monomer according to Formula (III):



wherein m is an integer from 0 to 5; X is $-\text{CH}_2-$, $-\text{CH}_2\text{-CH}_2-$, O , S , or $-\text{NH}-$; R^9 to R^{12} are independently selected from H , halogen, linear, branched or cyclic C_1 to C_{30} alkyl, alkylol, aryl, aralkyl, alkaryl, alkenyl or alkynyl; a non-carboxylic acid group containing an active hydrogen with a pK_a of 15 or less, and a carboxylic acid substituents selected from the group consisting of those in accordance with the formulas $-(\text{CH}_2)_q\text{C}(\text{O})\text{OH}$, $(\text{CH}_2)_q\text{C}(\text{R}^{25})_2\text{CH}(\text{R}^{25})(\text{C}(\text{O})\text{OH})$ or $-(\text{CH}_2)_q\text{C}(\text{R}^{25})_2\text{CH}(\text{C}(\text{O})\text{OH})_2$, wherein q is an integer from 0 to 10 and each occurrence of R^{25} is independently selected from H , halogen, linear, branched or cyclic C_1 to C_{10} alkyl, and linear, branched or cyclic C_1 to C_{10} halogenated alkyl; and wherein at least one of R^9 to R^{12} is a carboxylic acid substituent as described above.

Claim 22. (Original) The method of claim 21, wherein $m=0$ in the third monomer.

Claim 23. (Original) The method of claim 21, wherein the groups R^1 to R^4 and R^9 to R^{12} in the poly(cyclic)olefin monomers of Formula (I) and Formula (III) are independently selected such that three or more poly(cyclic)olefin monomers are included in the monomer composition.

Claim 24. (Previously Presented) The method of claim 1, wherein the chain transfer agent is one or more of an alkylsilane or alkylalkoxysilane selected from the group consisting of Si-H containing cyclotetrasiloxanes and compounds according to the formulae HSiR^{48}_3 , $\text{HSi}(\text{OR}^{48})_1\text{R}^{48}_2$, $\text{HSi}(\text{OR}^{48})_2\text{R}^{48}_1$, $\text{Si}(\text{OSiR}^{49}_3)_4$, and mixtures thereof,

wherein each occurrence of R^{48} is independently selected from linear, branched or cyclic C_1 to C_{10} alkyl and each occurrence of R^{49} is independently selected from H and linear, branched or cyclic C_1 to C_{10} alkyl, where at least one occurrence of R^{49} is H.

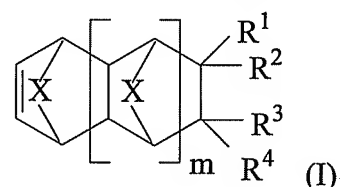
Claim 25. (Original) The method of claim 24, wherein the alkylsilanes are selected from the group consisting of triethylsilane, tri-isopropylsilane, and mixtures thereof.

Claim 26. (Original) The method of claim 1, wherein the combination of the monomer composition and catalyst is heated a temperature sufficient to effect polymerization.

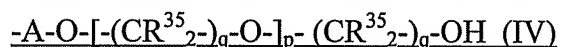
Claim 27. (Original) The method of claim 26, wherein the mixture is heated to a temperature of from 30 to 150°C.

Claims 28-39. (Cancelled)

Claim 40. (Currently Amended) A polymer comprising repeat units derived from the at least one of, a first monomer according to Formula (Ia), of claim 37



wherein X is selected from $-CH_2-$, $-CH_2-CH_2-$, O, S, and $-NH-$, m is an integer from 0 to 5, and at least one of R^1 - R^4 is a hydroxy alkyl ether according to Formula (IV),



wherein A is a linking group selected from C_1 to C_6 linear, branched, or cyclic alkylene, each occurrence of R^{35} is independently selected from H, methyl, ethyl and a halide, q is from 1 to 5, and p is from 0 to 3, and the remaining R^1 - R^4 are each hydrogen,
and

a second monomer according to Formula (I) wherein,
 $m=0$, X is $-CH_2-$, and at least one of R^1 - R^4 is $-(CH_2)_n\text{-C(OR}^{***})\text{-(CF}_3)_2$ where n is an integer

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from 0 to 10, and R*** is selected from H, -CH₂OR''', -C(O)OR''' and -C(O)R''', where R''' is selected from methyl, ethyl, t-butyl, and C₁ to C₂₀ linear or branched cycloaliphatic, and the remaining R¹-R⁴ are each H.

Claims 41-60. (Cancelled).

Claim 61. (Currently Amended) The ~~poly(cyclic)olefin~~ polymer of claim [36] 40, wherein the polymer has an optical density of less than 0.2 abs/μm at an exposure wavelength of 193 nm.

Claims 62-77. (Cancelled).